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Does simulated spaceflight modify epigenetic status during bone remodeling?

Nicholas J. Thomas[1,2], Rebecca J. Stevick[1,3], Luan H Tran[1], Mohit O. Nalavadi[1,2], Eduardo A.C. Almeida[1], Ruth K. Globus[1], Joshua S. Alwood[1]

[1]Space Biosciences Division, NASA Ames Research Center, [2]Blue Marble Space Institute of Science, [3]Space Life Sciences Training Program, NASA Ames Research Center

Little is known about the effects of spaceflight conditions on epigenetics. The term epigenetics describes changes to the genome that can affect expression of a gene without changes to the sequence of DNA. Epigenetic processes are thought to underlie cellular differentiation, where transcription of specific genes occurs in response to key stimuli, and may be heritable – passing from one cell to its daughter cell. We hypothesize that the mechanical environment during spaceflight, namely microgravity-induced weightlessness or exercise regulate gene expression in the osteoblast-lineage cells both to control bone formation by osteoblasts and bone resorption by osteoclasts, which continually shapes bone structure throughout life. Similarly we intend to evaluate how radiation regulates these same bone cell activity and differentiation related genes. We further hypothesize that the regulation in bone cell gene expression is at least partially controlled through epigenetic mechanisms of methylation or small non-coding RNA (microRNAs). We have acquired preliminary data suggesting that global genome methylation is modified in response to axial compression of the tibia — a model of exercise. We intend to pursue these hypotheses wherein we will evaluate changes in gene expression and, congruently, changes in epigenetic state in bones from mice subjected to the aforementioned conditions: hindlimb unloading to simulate weightlessness, axial compression of the tibia, or radiation exposure in order to gain insight into the role of epigenetics in spaceflight-induced bone loss.

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